Mean p_t fluctuations in minimum bias Pb+Pb collisions at the SPS

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Event-by-event fluctuations and in particular non-statistical fluctuation in the mean transverse momentum have attracted high attention during the last years (see, for example, [1] and references therein). The reasons for this are the sensitivity of the fluctuations to the underlying physics, such as phase transitions, creation of DCC, etc. The fluctuations in $\langle p_t \rangle$ have different contributions. The first one is the fluctuations due to a finite number of particles used to define $\langle p_t \rangle$ in the event. Such fluctuations are called the statistical fluctuations. One can evaluate them using inclusive p_t distributions and treating the production of all particles as totally independent. All fluctuations except the statistical ones are called non-statistical, or dynamical, fluctuations. In our analysis we concentrate on the centrality dependence of the non-statistical $\langle p_t \rangle$ fluctuations using NA49 minimum bias data.

We study the fluctuations in the mean transverse momentum of charged particles evaluated in the region of $2.5 < y < 5.0$ and $0.05 < p_t < 1.0$ GeV, and use the subevent method[2, 3] to address this question. In this method one subdivides the entire event (all particles in the region under study) into two subevents, "a" and "b", calculates $\langle p_t \rangle$ values on each of them and then studies the correlation between them.

$$\langle (\langle p_t \rangle_a - \langle \langle p_t \rangle_a \rangle)(\langle p_t \rangle_b - \langle \langle p_t \rangle_b \rangle) \rangle = \sigma^2_{\langle p_t \rangle, non-stat}. \quad (1)$$

The results of the analysis are presented in Fig. 1 as a function of centrality, namely, as a function of the ratio of the energy observed in the zero degree calorimeter to the beam energy. The result are shown as a ratio of non-statistical fluctuations in $\langle p_t \rangle$ to the value of $\langle \langle p_t \rangle \rangle$, the average value of $\langle p_t \rangle$ over all events. The fluctuations exhibit strong centrality dependence, decreasing for the most central collisions. Such a behavior is an indication of the equilibration processes in the evolution of the system. The value of the relative fluctuations of about 1% observed for central collisions is consistent with the upper limits obtained in [1].

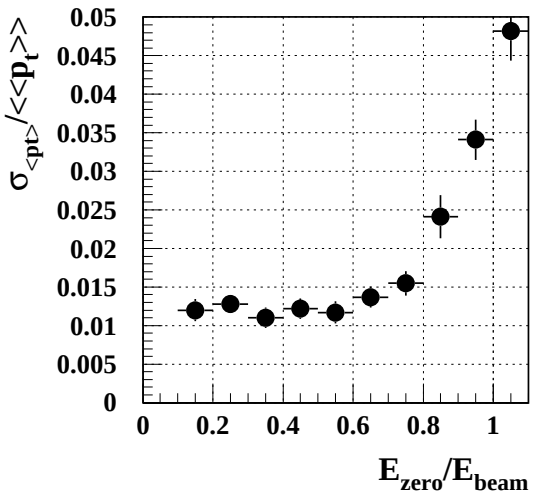

Figure 1: Dynamical fluctuations in $\langle p_t \rangle$ relative to $\langle \langle p_t \rangle \rangle$ as a function of centrality.

References

[1] H. Appelshauser et al., "Event-by-event transverse momentum fluctuations in central Pb+Pb collisions at 158 GeV per nucleon.", January 1999, submitted to Phys. Rev. Lett.

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[3] V. Koch, H.-G. Ritter, S. Voloshin, see this report, paper in preparation.